FORM PTO-1390 (REV. 1-98) U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER	U.S. APPLICATION NO (If known, see 37 CFR 1.5
GER5272	09/830721

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/US99/28950	07 Dec 1999	08 Dec 1998

TITLE OF INVENTION
IMPROVED WELDABLE ALUMINUM STUD

APPLICANT(S) FOR DO/EO/US
Schmitt et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☐ Other items or information:

"Express Mail" mailing label number EK956063244US ; Date of Deposit: 04-30-2001
I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington DC 20231.

SHARON GILDEN
(Printed name of person mailing paper or fee)

Sharon Gilden
(Signature of person mailing paper or fee)

U.S. APPLICATION NO (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/830721	PCT/US99/28950	GER5272

	CALCULATIONS PTO USE ONLY	
17. ☒ The following fees are submitted:		
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1070.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $930.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $790.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) $720.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $98.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 98.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	11 - 20 =	0	x $22.00	$
Independent claims	2 - 3 =	0	x $82.00	$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$
TOTAL OF ABOVE CALCULATIONS =				$
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28). +				$
SUBTOTAL =				$ 98.00
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				$
TOTAL NATIONAL FEE =				$ 98.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). $40.00 per property +				$ 40.00
TOTAL FEES ENCLOSED =				$ 138.00
			Amount to be refunded:	$
			charged:	$ 138.00

Adjustment Date: 06/22/2001 AYILMAZ
05/03/2001 DEDUVALL 00000003 09830721
01 FC:962 100.00 CR

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 02-2550 in the amount of $ 138.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2550. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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(410) 716-2867 (tele)
(410) 716-2610 (fax)

SIGNATURE

Edward D. Murphy
NAME

20,625
REGISTRATION NUMBER

IMPROVED WELDABLE ALUMINUM STUD

FIELD OF THE INVENTION

The invention relates generally to weldable materials and more particularly to weldable aluminum or aluminum alloy studs having a titanium containing material on at least a portion of a surface thereof, and methods of making the same.

BACKGROUND OF THE INVENTION

Weld-on parts are used in many areas of industrial manufacture. They enable metal connections without making holes and form a link between a basic structure and a component which is to be fastened. For example, a weld stud can serve to fasten pipe conduits, push buttons, plastic nuts or cable clips. Weld-on parts (e.g., studs) made of aluminum or aluminum alloys are known which can be welded to a basic part (e.g., a piece of sheet metal) which is also made of aluminum or aluminum alloys.

Under normal circumstances, freshly exposed aluminum in the presence of air immediately begins to oxidize. The oxide generally forms a layer over the entire surface and continues to grow thicker with the passage of time. The oxide layer is hard, adhesive, transparent, and up to several nanometers thick. In addition, in many circumstances, the thickness of the oxide layer may vary from spot to spot. The oxide layer is largely insoluble in a pH range between 4.5 and 8.5. Thus, the oxide layer provides the part

with protection against corrosion. However, the oxide layer does, in some circumstances, adversely affect further processing steps to which the welded part may be subjected.

While this condition applies equally to sheet aluminum and to aluminum studs, the process of manufacturing aluminum studs by cold working the metal makes the condition even worse because, after cold working, the surface may be comprised of areas of freshly exposed aluminum interspersed with different areas having varying oxide layer thicknesses. Thus, in the finished stud, the thickness of the oxide layer is random and variable.

This condition causes problems during the welding of the studs to aluminum sheets because the energy required to release electrons from the oxide is lower than the energy to release electrons from bare aluminum. For example, in arc welding a stud, the arc may initiate at the center point of a rounded weld head but, after some initial melting, the arc might jump or "blow" to an adjacent region, such as an area having a thick oxide layer. If this adjacent region is seriously off-center, the result may be an unsatisfactory weld.

Therefore, there exists a need for aluminum studs that have a relatively consistent oxide layer which is capable of being satisfactorily welded to a surface, without the occurrence of arc jumping or blowing. There also exists a need for methods of producing such aluminum studs.

SUMMARY OF THE INVENTION

It accordingly is an object of the present invention to provide an aluminum stud that has improved weldability.

It is another object of the present invention to provide an aluminum stud having a titanium containing material on at least a portion of a surface thereof.

It is another object of the present invention to provide a method for producing an aluminum stud that has improved weldability.

It is another object of the present invention to provide a method for producing an aluminum stud having a titanium material on at least a portion of a surface thereof.

In order to overcome the aforementioned disadvantages and achieve many of the aforementioned objects, the present invention provides a weldable part comprised of aluminum or an aluminum alloy, wherein the part has a titanium containing material on at least a portion of a surface thereof, wherein the layer of titanium containing material lowers contact resistance during a welding procedure.

The present invention also provides a method of forming a titanium containing material on at least a portion of at least one surface of a weldable part of aluminum or an aluminum alloy. The method includes the steps of: (1) providing a solution of titanium containing materials, and (2) contacting the part with the solution for a sufficient period of time to permit the titanium

containing material to be applied to the part; wherein the layer of titanium containing material lowers contact resistance during a welding procedure.

A more complete appreciation of the present invention and its scope can be obtained from an understanding the accompanying drawings, which are briefly summarized below, the followed detailed description of the invention, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a partial cross-sectional view of a weld stud, in accordance with one aspect of the present invention; and

Fig. 2 shows an elevational view of a weld stud having a threaded portion, in accordance with one aspect of the present invention.

The same reference numerals refer to the same parts throughout the various Figures.

DETAILED DESCRIPTION OF THE INVENTION

Initially, the weld-on part is pre-treated via known etching techniques to strip away aluminum oxides and thereby expose an aluminum or aluminum alloy surface. The titanium containing material is formed upon exposed aluminum or aluminum alloy portion of the weld-on part by immersing the part in an acidic solution including a concentration of titanium ions and, preferably, a chromium free acidic solution containing titanium ions. By way of non-

limiting example, one suitable acidic solution believed to contain a sufficient quantity of titanium ions, initially or through sequential addition during the application step, is known as ALODINE 2040, which is commercially available from Henkel Surface Technologies (Madison Heights, Michigan). The acidic solution utilized should provide a caustic passivation for the aluminum surface to be treated.

To prepare an ALODINE 2040 solution for use in accordance with the teachings of the present invention, 10-30 liters (preferably 15-20 liters) of the commercially available solution is mixed with a sufficient quantity of demineralized water to form a 1000 liter bath. At the above described ratio, the resulting bath should have a pH value of 1.25.

As noted above, the weld-on part is preferably a weld stud such as that shown in Figs. 1 and 2, made of aluminum or an aluminum alloy. The weld stud 1 has a shank 2 and a head 3 extending along one end of the shank. Preferably the head 3 has a conically tapered portion which forms a welding face 4.

To provide the weld-on part with a titanium containing material, the weld-on part is dipped or otherwise coated at a temperature of about 45°C in the acidic solution containing titanium ions. The treatment time, particularly if the part is dipped, is generally between 30-90 seconds, wherein the solution should have a free acid count of between about 6.1 to 18.3. Thus, as should be understood by those skilled in the art, the acidic solution is controlled by

the determination of the free acid count as well as via a measure of the dissolved aluminum. For each 1.0 decrease in the free acid count, additional solution should be added to the bath.

Once at least the welding face of the weld stud is provided with the titanium containing material, contact resistance between the weld-on part, a pin and the supporting structure or substrate is reduced. Providing the layer in the region of the welding face has a positive influence on the welding process. In particular, a qualitatively high grade welded connection is achieved, enabling the energy required to weld the pin to be reduced.

It is also preferred that the titanium containing material be of a sufficient thickness to prevent the formation of aluminum oxide on the weld-on part. As noted above, the thickness should be on the order of several nanometers.

Without being bound to a particular theory of the operation of the present invention, it is believed that the ALODINE 2040 causes a relatively thin and uniform thickness layer of titanium aluminum oxide crystals to be formed on the surface of the weld-on part. Although the titanium aluminum oxide layer may grow with time, which is generally undesirable, the rate of growth is much lower than for non-passivated aluminum, and the thickness of the titanium aluminum oxide layer remains relatively consistent.

The weld stud 1 is generally connected by means of arc welding to a structure or substrate (not shown) such as a sheet of a desired thickness.

For example, the weld studs may be adhered to sheets as thin as 0.8 mm on average. Preferably, the sheet will also be made of aluminum or an aluminum alloy. By way of non-limiting example, the sheet structure may be an autobody panel for a motor vehicle.

Referring to Fig. 2, there is shown a second embodiment of a weld stud 1 having a shank 2. However, in this embodiment, a Christmas-tree shaped thread 6 is formed on the shank 2. A welding head 3 is formed at a free end of the shank 2. The welding head 3 has a welding face 4, which comes into contact during arc welding with a substrate (not shown), such as an aluminum or aluminum alloy piece of sheet metal. The welding face 4 is provided with a layer 5 of a titanium containing material.

The foregoing description is considered illustrative only of the principles of the invention. Furthermore, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and process shown as described above. Accordingly, all suitable modifications and equivalents may be resorted to falling within the scope of the invention as defined by the claims which follow.

CLAIMS

What is claimed is:

1. A part attachable to a substrate via a welding process, comprised of aluminum or an aluminum alloy, wherein a surface of the part to be welded to the substrate is provided with a titanium containing material capable of lowering the contact resistance between the part and the substrate during a welding process.

2. The part according to Claim 1, wherein the titanium containing material is formed by contacting the part with an acidic solution containing titanium ions.

3. The part according to Claim 3, wherein the acidic solution is a passivating solution.

4. The part according to Claim 3, wherein the acidic solution is chromium-free.

5. The part according to Claim 1, wherein said acidic solution includes ALODINE 2040.

6. The part according to Claim 1, wherein the part is a weld stud having a welding face.

7. The part according to Claim 6, wherein at least a portion of the welding face is provided with a titanium aluminum oxide layer.

8. The part according to Claim 7 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

9. A method of producing a weldable aluminum part having titanium dispersed along a surface thereof, said method comprising the steps of:

providing an acidic solution containing titanium ions; and

contacting the weldable aluminum part with the acidic solution for a sufficient period of time to permit the application of titanium along a surface of the part;

whereby the contact resistance of the part is lowered during a subsequent welding process.

10. The method according to Claim 9, wherein the acidic solution is a passivating solution.

11. The method according to Claim 9, wherein the acidic solution is chromium-free.

12. The method according to Claim 9, wherein said acidic solution includes ALODINE 2040.

13. The method according to Claim 9, wherein the part is a weld stud having a welding face.

14. The method according to Claim 9, wherein at least a portion of the welding face is provided with a titanium aluminum oxide layer.

15. The method according to Claim 15 wherein said part is applied to a substrate having an average thickness of as little as 0.8 mm.

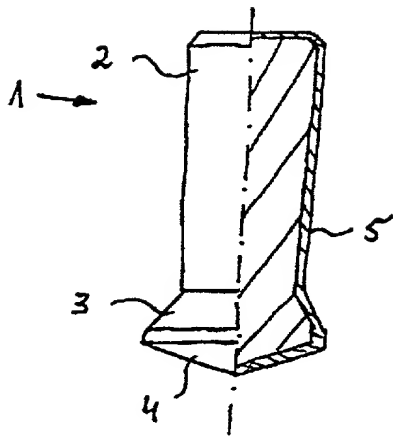

Fig. 1

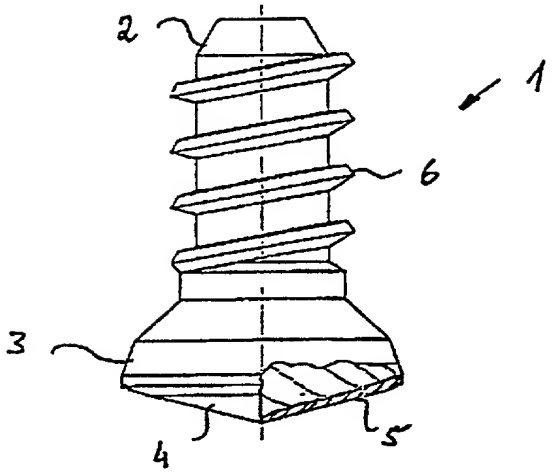

Fig. 2

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	GER5272
First Named Inventor	Schmitt et al.
COMPLETE IF KNOWN	
Application Number	/
Filing Date	
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

IMPROVED WELDABLE ALUMINUM STUD

(Title of the Invention)

the specification of which
☐ is attached hereto
OR
☒ was filed on (MM/DD/YYYY) 12/07/1999 as United States Application Number or PCT International Application Number PCT/US99/28950 and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
DE 19856613.1	Germany	12/08/1998	☐	☐	☒
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number *(if applicable)*

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*

OR

☒ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
Edward D. Murphy	20,625		
Charles E. Yocum	30,121		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] *OR* ☐ Correspondence address below

Name	Edward D. Murphy, Esq.				
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Address	701 East Joppa Road, TW199				
City	Towson	State	MD	ZIP	21286
Country	U.S.A.	Telephone	410-716-2867	Fax	410-716-2610

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Klaus G.	SCHMITT

Inventor's Signature	Klaus G. Schmitt					Date	04-23-01
Residence: City	Giessen	State		Country	Germany DEX	Citizenship	DE
Post Office Address	Alicenstrasse 22,						
Post Office Address							
City	Giessen	State		ZIP	D-35190	Country	Germany

☐ Additional inventors are being named on the 1 supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION

ADDITIONAL INVENTOR(S)
Supplemental Sheet
Page 1 of 1

2-00

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor						
Given Name (first and middle [if any])			Family Name or Surname				
Michael			KRENGEL				
Inventor's Signature	Michael Krengel				Date	04-20-2001	
Residence: City	Giessen	State		Country	DEX Germany	Citizenship	DE
Post Office Address							
Post Office Address	Giessenerstrasse 123						
City	Giessen	State		ZIP	D-35396	Country	Germany

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor						
Given Name (first and middle [if any])			Family Name or Surname				
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		ZIP		Country	

Name of Additional Joint Inventor, if any:	☐ A petition has been filed for this unsigned inventor						
Given Name (first and middle [if any])			Family Name or Surname				
Inventor's Signature					Date		
Residence: City		State		Country		Citizenship	
Post Office Address							
Post Office Address							
City		State		ZIP		Country	

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